August 2010

Technical Bulletin

Permit to Take Water Program

Monitoring and Reporting of Water Takings

This bulletin is to assist permit holders in understanding the monitoring and reporting requirements for water takings in the Water Taking Regulation (O. Reg. 387/04).

In Ontario, water takings are governed by the Ontario Water Resources Act (OWRA) and the Water Taking Regulation. Section 34 of the OWRA requires anyone taking more than 50,000 litres of water a day, with some limited exceptions, to obtain a Permit to Take Water (PTTW) from the Ministry of the Environment (ministry).

The Water Taking Regulation took effect January 1, 2005. It introduced improvements to the Permit to Take Water Program, including strengthening the factors to be considered by the ministry when assessing water taking applications, and introducing mandatory monitoring and reporting of water takings by all permit holders.

Tracking water takings supports improved water management in the province, including water conservation, the development of water budgets, and the reporting of water use under the Great Lakes Charter. By using water more efficiently, every permit holder helps ensure a sustainable supply of water for the future.

Section 9 of the Water Taking Regulation requires all permit holders to collect, record and report data on the volume of water taken daily for the period January 1 to December 31 to the Ministry of the Environment by March 31 of the following year. Under O. Reg. 387/04, data collection and reporting was phased-in over three years, as summarized below. Specific details for the phase-in for specific permit holders can be found in the regulation.

Phase 1 permit holders

Effective July 1, 2005, the holders of permits for the following purposes must record data on the volume of water taken daily, and report it annually on or before March 31, beginning in 2006:

- large and small municipal residential systems as defined in Ontario Regulation 170/03
- industrial dischargers regulated by the nine Municipal Industrial Strategy for Abatement (MISA) regulations
- water takings that remove water from the watershed, as defined in Section 5 of the O. Reg. 387/04

Phase 2 permit holders

Effective January 1, 2006, the holders of permits for the following purposes must record the data on the volume of water taken daily, and report it annually on or before March 31, beginning in 2007:

- all other industrial and commercial purposes not described in Phase 1
- wildlife and conservation

Phase 3 permit holders

Effective January 1, 2007, holders of permits for the following purposes must record the data on the volume of water taken daily, and report it annually on or before March 31, beginning in 2008:

- all other drinking water systems regulated by Ontario Regulation 170/03 not described in Phase 1
- agriculture
- all other purposes not described in Phases 1 and 2

Monitoring a water taking

Each Permit to Take Water lists at least one and often several water taking sources. The volume of water taken daily from each source is to be monitored.

The data on the volume of water taken daily must be measured by a flow meter or calculated using a method acceptable to the O. Reg. 387/04, S. 9 Director. Details on metering and calculation methods are found in Appendix A, however, individual permits may impose specific monitoring methods which must be followed in parallel with the monitoring and reporting requirements specified in O. Reg. 387/04.

Permits to Take Water are issued for various types of water takings including drawing water from wells, inlets from surface water sources and by structures or works which divert or store water. Some specific examples of water taking reporting methods associated with these later types of water takings are provided in Appendix B.

Record keeping requirements for water takings

Permit holders should maintain an on-site log of daily water takings. Permit holders should also maintain, on file, the details of how water takings are measured or calculated for reporting purposes under O. Reg. 387/04. Some specific suggestions for record keeping are provided in Appendix B.

Monitoring of water takings by a calculation method acceptable to the Director

Where the use of a flow or a volumetric meter is not feasible or practical, the ministry allows calculation of daily water takings using acceptable methods. Acceptable methods for both closed conduit and open channel systems are discussed in Appendix A and Appendix B.

The calculated volume of water taken daily is required to be within 20% accuracy or better. To ensure the calculation accuracy is 20% or better, it is recommended that at least once a year a meter be used to cross-check the calculated daily volume of water taken.

Annual reporting requirements

Permit holders must submit the data on the total volume of water taken daily each calendar year (January 1 to December 31), to the Ministry of the Environment on or before March 31 of the following year. For example, water takings for January 1, 2006 to December 31, 2006 must be reported by March 31, 2007.

The monitoring and reporting requirements contained in O. Reg. 387/04 work in conjunction with conditions imposed in a permit. Where a permit requires the permit holder to collect information at a greater frequency or to collect additional information (for example, recording a daily maximum flow and/or a requirement that all water taking information be analyzed by a qualified professional and reported annually), the permit holder must still comply with these conditions. In addition, the data on the total volume of water taken daily must be submitted to the ministry annually, notwithstanding any contrary conditions in the permit that only require the permit holder to retain the data on site.

How to submit water taking data

Permit holders are expected to submit water taking data to the ministry electronically. Electronic submission is the preferred format but if electronic reporting is not feasible, hard-copy (paper) submissions will be accepted. Details for electronic and hard-copy data submission are outlined below.

Electronic submission

The ministry has developed an internet-based Water Taking Reporting System (WTRS) that allows permit holders to enter their water taking data electronically, eliminating the need for a paper submission. This system is accessible through the ministry's web site at http://www.ene.gov.on.ca/envision/water/pttw.htm. A completed electronic submission satisfies the reporting requirements under O. Reg. 387/04. The system is fully secure and individual permit holders will access, enter and view only their own data. The ministry will supply each permit holder with a password and user ID to access the WTRS.

Hard-copy (paper) submission

The ministry will accept water taking data in paper format from permit holders who cannot submit their data electronically. Appendix C contains a water taking submission form that must be completed and submitted. A permit holder's customized submission form can be obtained by calling the Help Desk at 416-235-6322 or 1-877-344-2011 or Emailing to: WTRSHelpdesk@ontario.ca.

The specific information that must be included on a paper submission:

- Permit To Take Water number
- Permit holder's name, address, telephone number
- For each source listed on the permit, the daily water taking amount taken, measurement units and whether the amount was measured or calculated
- Signature of the permit holder

The hard-copy submissions are to be sent to:

Ministry of the Environment
Environmental Monitoring and Reporting Branch
Water Taking Reporting System
125 Resources Road, West Wing
Toronto, ON M9P 3V6

Monitoring and reporting resources

Specific methods of monitoring water takings using a meter and by calculation are described in Appendix A.

Monitoring of water takings by the agricultural sector

Appendix D at the end of this technical bulletin provides metering and calculation methods for water takings to assist agricultural water takers with meeting their regulatory obligations under O. Reg. 387/04.

Where to obtain more information on water metering

For general information on the types and use of water meters and methods of metering, please refer to the following publications:

- "Establishing a Metering Plan to Account for Water Use and Loss", available at www.infraguide.ca or by contacting Infraguide at 1-866/330-3350
- "Water meters – Selection, Installation, Testing and Maintenance" (M6 manual), available at www.awwa.org or by contacting the American Water Works Association (AWWA) at 1-800/926-7337
- "Water Metering Trade Sector Review", available at the Measurement Canada web site at www.strategis.ic.gc.ca/engdoc/main.html or by phone at 613/952-5405

- "Water Measurement Manual: A Water Resources Technical Publication", available at the U.S. Department of Interior web site at www.usbr.gov (follow link to *Publications and Reports*)

- "Integrated Water Meter Management", by F. Arregui, E. Cabrera Jr., R. Cobacho, available at www.iwapublishing.com or by contacting the publisher at +44 1206 796351

Where to obtain information on Permit to Take Water monitoring and reporting requirements

Please contact the **WTRS Helpdesk** at 416/235-6322 or 1-877/344-2011 or by Email at WTRSHelpdesk@ontario.ca.

General information on the monitoring and reporting requirements is available at the ministry's Public Information Centre at 1-800/565-4923 (within the Toronto calling area at 416/325-4000) or on-line at the ministry web site at http://www.ene.gov.on.ca/envision/water/pttw.htm.

Where to obtain information regarding a specific permit

Information specific to the permit requirements and conditions is available at the Ministry of the Environment Regional Offices:

Eastern Region (Kingston)
Tel. 613/549-4000 or 1-800/267-0974

Northern Region (Sudbury)
Tel. 705/564-3237 or 1-800/890-8516

Central Region (Toronto)
Tel. 416/326-6700 or 1-800/810-8048

Southwest Region (London)
Tel. 519/873-5000 or 1-800/265-7672

Northern Region (Thunder Bay)
Tel. 807/475-1205 or 1-800/875-7772

West Central Region (Hamilton)
Tel. 905/521-7640 or 1-800/668-4557

This bulletin is provided for general guidance purposes only. To determine specific legal responsibilities, please refer directly to the Ontario Water Resources Act, Water Taking Regulation (O. Reg. 387/04) and the conditions set in the Permit to Take Water.

Appendix A - Monitoring and reporting resources

Specific methods of monitoring water takings using a meter and by calculation are described below:

Monitoring of water takings by using a meter

Continuous metering at the point of water taking is the normally accepted, most accurate, and easy-to-use method of monitoring the volume of water taken daily (in litres per day).

For MISA facilities governed by the Ontario Regulations 560/94, 215/95,561/94, 64/95, 214/95, 562/94, 63/95, 537/93 and 760/93, the ministry will accept, in place of metering at the point of water taking, a calculation that aggregates metered daily total volume discharged from all discharge points and includes all estimated losses between the point of taking of raw water at source and the discharge of effluent from the facility (for example, evaporation or other losses). The calculation should be prepared by a qualified person, such as a professional engineer.

Selecting the right water meter

There are several types of water meters available for use in either closed conduit or open channel water systems. In closed systems, water flows in enclosed pressure conduits (pipes) and the water flow is often measured by inserting a meter into the line. In an open channel, water flows through a channel with an open or exposed surface.

It is best to consult with a water meter supplier or metering contractor to select the right meter for the facility or operation. A list of some types of water meters for both closed conduit and open channel systems can be found in the resource section of this bulletin.

Maintenance and calibration of water meters

To ensure the continued accuracy of the meter, it should be maintained on a regular basis and calibrated annually. Maintenance and calibration records for water meters used for monitoring daily water takings and for the pump or pumps used to extract the water should also be kept on site for inspection by the ministry.

Monitoring water takings by using a meter

There are numerous types of water meters available on the market for both closed conduit and open channel systems. Below is a description of some types of available water meters for volumetric measurement.

Closed conduit metering systems

Water meters for closed conduits or pipes are typically inserted directly into the line, but there are non-intrusive models available. Table 1 provides a brief description of some types of available water meters for volumetric measurement for use in closed conduit systems.

Table 1 – Closed conduit water meters

Meter Type	Pipe Diameter	Accuracy	Intrusive	Remote Reading	External Power Source	Worth Noting
Differential Pressure	Typically > 300 mm	±2% – ±5%	Yes	Yes	No	Commonly used in larger applications and includes venturi–style, orifice plate and V-cone type meters. Long life-span with average maintenance and calibration requirements.
Magnetic	100 – 900 mm	±2%	Yes	Yes	Yes*	Commonly used in municipal and industrial applications. Long life-span with low maintenance and calibration requirements.
Propeller & Turbine	50 – 600 mm	±2% - ±5%	Yes	Yes	No	Commonly used in municipal and industrial applications. Offer a lower cost solution to metering, but due to moving parts, higher calibration and maintenance requirements
Ultrasonic	> 150 mm	±2% - ±5%	No	Yes	Yes	Good for temporary metering and for flow metering in locations where isolating the flow is impossible or very costly. Average maintenance requirements
Vortex	100 – 400 mm	±2%	Yes	Yes	Yes	Commonly used in industrial applications. Low maintenance and calibration requirements, but proper installation critical.
Velocity Jet	25 – 150 mm (for single jet) 15 – 50 mm (for multi-jet)	±2%	Yes	Yes	No	Lower cost solution to metering smaller sized conduits with varying flow rates. More frequent calibration and maintenance requirements.
Insertion	150 – 1500 mm	±5%	Yes	Yes	Yes*	For use in difficult installation situations or for temporary flow monitoring. Due to moving parts, higher maintenance and calibration requirements
Positive Displacement	15 – 60 mm	±2%	Yes	Yes	No	Commonly used in residential and small commercial applications and in industrial applications for accurate volumetric metering. Long life-span with low maintenance requirements.

** External power source not required for some models*

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Open channel metering systems

Open channel metering systems are used on gravity-fed applications and are normally metered by one of the following methods:

1. **Area / Velocity water meters** - A water flow velocity sensor and depth sensor is placed at the bottom of an open channel of known configuration. Flow and volumetric readings are obtained by determining the cross-sectional area of the water flow and multiplying it by the sensed velocity.

2. **Weir flow measurement** - A weir is a calibrated structure used to relate water level to flow. Water flow over a weir will create a unique head-to-discharge relationship, thus by measuring the head above the weir crest; an accurate flow-rate can be established.

3. **Flume flow measurement** - A flume is a specially shaped open channel flow section that restricts the channel area in such a way that the depth of flow in the channel restrictions is directly proportional to the flow of water.

To obtain daily volumetric measurements for Weir-flow and Flume-flow metering systems, an instrument to measure the water level (depth of flow) and recording device (such as a data logger) are required. A calculation must be made manually or automatically to convert the flow rate measurement and daily taking times into a daily volumetric measurement.

Monitoring of water takings by using calculation methods

Calculation method for closed conduit systems

In order to demonstrate that the calculation method used for the daily volume of water taken in closed conduit systems is acceptable, a permit holder is required to keep on site the following information (at a minimum) for inspection:

Daily pump run-time – Daily pump run-time is the amount of time each day (24 hour period) the pump is in operation. The pump run-time can be recorded with an automatic recording device, such as an hour meter, affixed directly to the pump.

Pump discharge pressure head – Pump discharge pressure head is the total water pressure expressed in elevation at the point the water is discharged from the pump itself. Pump discharge pressure head is obtained by monitoring the pump with a pressure head transducer and recording device, such as a data logger.

Suction head – Suction head is the vertical distance between the pumped water (at the point of taking) and the pump (the lift). If the water source and pump are both located at the same level or height then the suction head would be zero. If the water is taken from a well or a surface source located down-hill from the pump, it will be necessary to determine the suction head by determining the elevation difference between the water source and the pump.

Total Dynamic Head (TDH) – TDH is the pump discharge pressure head plus the difference in head between the pumped water extraction point and the pump discharge point. TDH is calculated by adding the total pump discharge pressure head and the suction head.

TDH = pump discharge pressure head + suction head

Pump curve – A pump curve is a graph showing the range of head-discharge performance for a specific pump. The pump curve specific to the type of pump should be included with the literature supplied by the pump manufacturer or installer. Pump curves from the manufacturer have at least an accuracy of 20%. The accuracy of the pump curve can be improved to within 10% if a site-specific pump curve is developed at the actual pump installation point. If a pump curve cannot be located, identify the model number on the pump and contact the manufacturer to request a pump curve.

Average pump flow rate – The average pump flow rate is obtained from the pump curve using the Total Dynamic Head (TDH) measurement.

To calculate the daily volume of water taken, multiply the average pump flow rate by the daily pump run-time:

Daily volume = average pump flow rate X daily pump run-time

It is strongly recommended that the pump be calibrated at minimum annually, or after any maintenance or part replacement and routinely run pump curve tests to ensure the accuracy of the daily water taking volume calculations.

Calculation method for open channel systems

Open channel systems involve the use of a canal, ditch, stream or other constructed infrastructure to divert water from its source. In order to demonstrate that the calculation method used for daily volume of water taken from open channel systems is acceptable, a permit holder is required to keep on site the following information:

Stage-discharge rating curve – A stage-discharge rating curve depicts an average flow rate for a certain depth of water (stage) in an open channel. In order to develop a stage-discharge rating curve, detailed recording of actual discharge at several stages (depths of water) must be taken. Once the stage-discharge curve is established, volume measurements can be calculated based on the depth of water recorded at set intervals (normally every 15 minutes) over a day.

Open channel discharge – The open channel discharge needed for the development of a stage-discharge rating curve can be recorded using a temporary open channel metering system as described above in the section titled "Open channel metering systems." In addition, discharge can be measured using standard river gauging techniques. Stream or river gauging is a graphic integration of the velocity distribution over the cross-sectional area of the open channel. The process can be difficult for streams and ditches as the cross-sectional area at the measurement location must be established. It is much easier to undertake this process in canals of constant geometry. Velocity measurements are taken using, current, magnetic, acoustic or Doppler velocity meters.

Open channel stage (water level) – The open channel stage is measured using a depth transducer or level transducer and recorded using either a chart or data recorder. This provides a constant level or stage indication from which an average flow rate can be established from the stage-discharge rating curve.

To calculate the daily volume of water taken, the average daily open channel flow rate (calculated from the stage-discharge rating curve and average stage depth), is multiplied by the total daily taking time (24 hours in systems with no control gates).

> Daily Volume = average open channel flow rate X daily taking time

It should be noted that volumetric calculations using the stage-discharge rating curve method require frequent verification of the stage-discharge rating curve for streams and ditches as channel geometry may change rapidly. It is recommended that the stage-discharge rating curve be calibrated on an annual basis.

APPENDIX B - Monitoring methods for some specific types of water takings including dams, reservoirs, wetlands, conservation purposes and diversions

The following table provides examples of monitoring methods for five specific types of water takings:

Water Taking Type	Description of Water Taking Type	How to Monitor and Report
Water power dams and reservoirs	Water power facilities regulated under the Lakes and Rivers Improvement Act (LRIA). Many such facilities will have a Dam Operations Plan, including flows and levels.	The water taking is water stored in the reservoir. Report the water taken associated with changes in stage less releases and seepage. Follow the existing monitoring requirements in the Dam Operations Plan. Where the time-step for staging measurement is greater than daily, calculate or estimate the water taken between the known stages. Downstream flows are not reported under O. Reg. 387/04. Permit holder must maintain records of how calculations and estimates of water takings based on available stages were made.
Dams and reservoirs	Dams and reservoirs not used for water power production	Report water taken into or stored in the reservoir as the water taking. Downstream flows are not reported under O. Reg. 387/04.
Diversions between watersheds	Water is diverted from one watershed to another.	Report the water taken.
Simple diversions (same stream/watershed)	The stream channel has been entirely or partly realigned and water is returned to the stream unchanged in quantity and quality.	Report “no water taken” after project completion. WTRS provides a simple method for indicating that no water was taken for the reporting period.

The above list is not intended to be inclusive or comprehensive but to act as general guide to permit holders for the above listed types of water takings to comply with the monitoring and reporting requirements in O. Reg. 387/04.

APPENDIX C - Water taking submission form

Ontario

Permit #	
Permit holder's name	
Address	
Telephone number	
Signature of permit holder (or person authorized to submit this information on behalf of the client)	

Source Information			
Source Name		**Max. num. of days taken per year**	
Source/ Type		**Zone**	
Specific purpose		**Easting**	
Major category		**Northing**	
Max. taken per day (litre)			

Water Taking Data					
Method of determination: (Please check)	Metered		Calculated		
Units of measure: (Please check)	Litres	US Gallons	Imperial Gallons	Acre-inch	Cubic meter

Month				**Year**			
Date		**Date**		**Date**		**Date**	
1		**2**		**3**		**4**	
5		**6**		**7**		**8**	
9		**10**		**11**		**12**	
13		**14**		**15**		**16**	
17		**18**		**19**		**20**	
21		**22**		**23**		**24**	
25		**26**		**27**		**28**	
29		**30**		**31**		**Total**	

APPENDIX D – Monitoring methods for agricultural irrigation water takings

This appendix is to assist permit holders for irrigation water taking. The five methods described below were provided by the Ministry of Agriculture, Food and Rural Affairs. These methods will be considered as methods acceptable to the Ministry of the Environment for the monitoring requirements of the Water Taking Regulation (O. Reg. 387/04).

1. Monitoring of water takings by using a meter

A water meter is installed at the point of water taking. This is generally accepted as the most accurate and easy-to-use method of monitoring the volume of water taken daily. This method directly measures how much water has been used at any point in time. Record the volume of water pumped (write down meter reading) on each irrigation day. Alternatively the meter can be equipped with a data logger to automatically record the volume of water pumped each day. Water metering is described in more detail earlier in this Technical Bulletin.

2. Monitoring of water takings by a calculation – Pump Rate x Time method

The daily volume of water taken by an irrigation system may be calculated by multiplying the time the pump is operating by the pumping rate (Daily pump run time x Average pump flow rate). A permit holder is required to keep records of the daily operating time (hours and minutes) and the pumping rate used that day. The pump run-time can be measured with an hour meter or by manually writing down the start and stop time of the irrigation and the difference is the run time. The permit holder must record the pump run time each day that irrigation occurs. There are 4 methods described below, which can be used to determine the pumping rate. Speak with your irrigation equipment dealer or pump manufacturer about which method to use for your system.

a. Pumping Rate from Head/Discharge curve. Determine pressure from a gauge at pump discharge point and add to it the suction head (vertical distance between water surface and the pump (lift)). Using this pressure, determine Pumping Rate from the pump manufacturers curve.
b. Pumping Rate from Nozzle size and Gun pressure chart. Contact your irrigation equipment supplier for the chart.
c. Pumping Rate from Nozzle package on Centre Pivot. Contact your irrigation equipment supplier for the Pumping Rate of your pivot & nozzles.
d. Pumping Rate from an Amperage/Horse Power curve (for electric pumping stations). Contact your pump dealer or manufacturer for the curve.

3. Monitoring of water takings by calculation – Area Irrigated x Depth of Application (rain gauges)

The daily volume of water taken by an irrigation system may be calculated by multiplying the area irrigated by the depth of water applied (Multiply Area x Depth of Water). For example, if you have 7 acres and you applied 1.5 inches of water, the total volume is 7 acres x 1.5 inches = 10.5 acre-inches. The depth applied is determined or verified by using a set of rain gauges set up in the irrigated field. The rain gauges should be of identical size and shape. The depth test requires a minimum of 16 gauges divided evenly between 4 areas of the field (2 areas close to the pumping point, 2 areas farthest from the pumping point)

a. For sprinkler systems, place the 4 rain gauges per area (16 gauges total):

- Uniformly spaced between two lateral lines
- Perpendicular to the direction of the laterals

b. For traveling gun systems, place the 4 rain gauges per area (16 gauges total):
- Uniformly spaced between two travel lanes and perpendicular to the direction of the gun pull

c. For centre pivot systems, place all 16 rain gauges:
- Uniformly spaced in a line starting 50 meters from the pivot point and extending to 10 meters from the wetted perimeter of the field
- 16 gauges will suffice if the pivot is 200 meters or less. More gauges are required for longer systems. (e.g. 24 for 400 meter pivot)

Operate the irrigation system as per the normal operation (at least 30 minutes) until the irrigation application is complete.

For all overhead systems:

- Record the depth of water in each gauge
- Calculate the average of all the readings
- Multiply the average Depth of water x Area irrigated

4. Monitoring of water takings by calculation – Drip Irrigation system calibration

For drip systems make use of 16 collection pans:

- The 16 collection pans should be spread evenly roughout the zone to be irrigated – one collection pan per discharging emitter
- Take at least 4 measurements near the beginning of laterals and at least 4 measurements near the end of laterals furthest from the zone control valve
- Operate the irrigation system as per the normal application (at least 30 minutes) and record the operating time
- Measure the volume of water in each pan (use a graduated cylinder)
- Calculate the average volume
- Multiply the average volume by the number of emitters in the zone (this will give the total volume of water applied in the zone)

- The volume of water pumped will be the same if the system is operated for the same time each day
- The volume of water pumped for a shorter or longer time period may be calculated by multiplying the rate established above, by the actual operating time. Example: A system uses 76,000 litres in 3 hours. How many litres will be used in 4 hours? Answer: 4 hours x 76,000 litres / 3 hours = 101,333 litres used if the system was operated for 4 hours

5. Monitoring of water takings by calculation – Drip Irrigation systems emitter/tape Flow Rate x Number of emitters/length of tape per zone x Time

The daily volume of water taking may be calculated for a drip irrigation system by multiplying the emitter or tape flow rate by the number of emitters or the length of the drip tape in that zone. That "zone flow rate" can now be multiplied by the daily operating time to give the daily water volume. For example a system with drip tape of 0.340 GPM/100ft where each zone has 60 rows 500 ft long will have a zone flow

rate of 0.340 GPM/100ft x 60 x 500ft = 102 US gallons per minute/zone. In this example, the farmer operates the system for 3 hours every day. Therefore the water volume is 102 GPM/zone x 180 minutes (3 hours) = 18360 US gallons per zone. Other methods of monitoring may be used other than those listed but they must first be approved by the Director otherwise they are invalid.

Information in this appendix has been modified from "Irrigation System Assessment Guide, The Canada – British Columbia Environmental Farm Plan Program" June 2005. Available at: http://www.agf.gov.bc.ca/resmgmt/publist/500Series/551400-0.pdf

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